

## PATENT COOPERATION TREATY

## PCT

15 JUL 2004

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)



REC'D 13 APR 2004

WIPO PCT

Applicant's or agent's file reference	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB 02/05905	International filing date (day/month/year) 23.12.2002	Priority date (day/month/year) 16.01.2002
International Patent Classification (IPC) or both national classification and IPC. C01B3/38, C01B3/38		
Applicant JOHNSON MATTHEY PLC et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.  
  
☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).  
  
 These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:
  - I ☒ Basis of the opinion
  - II ☐ Priority
  - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
  - IV ☐ Lack of unity of invention
  - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
  - VI ☐ Certain documents cited
  - VII ☐ Certain defects in the international application
  - VIII ☐ Certain observations on the international application

Date of submission of the demand  24.07.2003	Date of completion of this report  13.04.2004
Name and mailing address of the international preliminary examining authority:   European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer  Telephone No. +31 70 340-  

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No.

**PCT/GB 02/05905**

REC'D 27 MAY 2004  
PCT/GB 02/05905

**I. Basis of the report**

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17):*

**Description, Pages**

1-9 as originally filed

**Claims, Numbers**

1-9 as received by fax of 09.12.03 and letter of 12.12.03

**Drawings, Sheets**

1/1 as originally filed

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

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5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

**see separate sheet**

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes: Claims	1-9
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	1-9
Industrial applicability (IA)	Yes: Claims	1-9
	No: Claims	

**2. Citations and explanations**

**see separate sheet**

**Re Item I**

**Basis of the report**

1. Claim 1 has been amended by changing "gaseous **low** hydrocarbon feedstock" to "gaseous hydrocarbon feedstock". In claim 6 a very similar amendment was made: "**low** hydrocarbon feedstock **gas**" was changed to "hydrocarbon feedstock". The alleged basis for these amendments is page 1, line 30 and page 7, line 18.

The passage on page 1 cannot serve as basis for the amendment, since this passage merely describes the hydrocarbons used in the prior art reforming processes. The second passage, however, is concerned with the subject-matter of the application. This passage mentions that a "desulphurised hydrocarbon feedstock" is fed to the reactor.

Claims 1 and 6 do not specify that the hydrocarbon is desulphurised and the subject-matter therefore extends to hydrocarbons that still contain sulphur. Subject-matter has been added, contrary to Rule 70.2(c) PCT.

For this international preliminary examination report, claims 1 and 6 have been interpreted as specifying that the hydrocarbon is desulphurised.

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Reference is made to the following documents:

D1: US-A-6172124 (Syntroleum)  
D2: WO-A-00/09441 (ICI PLC)  
D3: US-A-5245110 (Starchem Inc.)

1. The present application does not meet the requirements of Article 33(3) PCT because the subject-matter of claim 1 does not involve an inventive step.

Claims 1 and 6 have been reformulated to specify that the oxygen stream used in the reforming contains more than 90% oxygen. Due to this reformulation of claims 1 and 6, document D2 should now be considered to be the closest prior art.

Document D2 discloses a process for the production of synthesis gas for use in the synthesis of hydrocarbons. A primary reforming is followed by a secondary reforming, the product of the secondary reforming is used to heat the primary reforming. The synthesis gas is cooled to condense water therefrom. The tail gas from the Fischer-Tropsch synthesis, which comprises carbon dioxide, is recycled to the reformer (see claim 1; page 7, lines 11-22).

The only difference between claim 1 and document D2 lies in the fact that in claim 1 at least part of the tail gas is combusted and the combustion gas used in a turbine, whereas in D2 the tail gas is recycled to the reformer.

Document D1, however, shows that Fischer-Tropsch tail gas contains sufficient energy to combust it and pass it through a turbine (see claim 1). The fact that in D1 air is used seems to be of no importance. It should in this respect be noted that present claim 1 does not define that in the combustion for the turbine more than 90% oxygen is used.

The person skilled in the art in petrochemistry is always looking for improvements in the energy balances. He would certainly consider combusting at least part of the tail gas and feeding this to a turbine in the process of D2.

The subject-matter of claim 1 does not involve an inventive step.

2. The subject-matter of claim 6, directed to the chemical apparatus for performing the process of claim 1, does not involve an inventive step for the same reasons as claim 1.
3. The subject-matter of claims 2-5 and 7-9 also does not involve an inventive step.
  - 3.1. Document D1 discloses the recovery of heat from the exhaust gases of the gas turbine by passage through a heat exchanger (see column 4, lines 46-51). The subject-matter of claim 5 does not involve an inventive step.
  - 3.2. Document D3 discloses a process for the separation of oxygen from air integrated with the production of synthesis gas, followed by a Fischer-Tropsch conversion (see claims). The subject-matter of claims 2-4 and 7-9 does not involve an inventive step.

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4. It is not clear if there is any subject-matter which could form the basis for a main claim which is novel and involves an inventive step.

12. 12. 2003

Claims

(54)

1. A process for the production of hydrocarbons by the Fischer-Tropsch reaction comprising
  - a) subjecting a mixture of a gaseous hydrocarbon feedstock and steam to steam reforming by:
    - i. passing the mixture over a catalyst disposed in heated tubes in a heat exchange reformer,
    - ii. subjecting the resultant primary reformed gas to secondary reforming by partially combusting the primary reformed gas with oxygen provided by an oxygen-rich gas comprising >90% oxygen and bringing the resultant partially combusted gas towards equilibrium over a secondary reforming catalyst, and
    - iii. using the resultant secondary reformed gas to heat the tubes of the heat exchange reformer, thereby producing a partially cooled reformed gas,
  - b) further cooling the partially cooled reformed gas to below the dew point of the steam therein to condense water and separating condensed water to give a de-watered synthesis gas,
  - c) passing said de-watered synthesis gas through a hydrocarbon synthesis reaction to form a reaction products stream,
  - d) separating at least a part of said reaction products stream into a hydrocarbons product stream and a tail gas stream,
  - e) combusting at least a part of said tail gas to produce a combustion gas, and
  - f) using said combustion gas to drive a turbine, thereby to produce power from said turbine.
2. A process as claimed in claim 1, wherein said oxygen rich gas is provided by an air separation unit and wherein nitrogen generated by said air separation unit is fed to said turbine.
3. A process as claimed in claim 1 or claim 2, wherein said turbine is a part of an integrated gas turbine apparatus comprising an air compressor for supplying compressed air for use in said gas turbine apparatus, a combustion chamber and said turbine.
4. A process as claimed in claim 3, wherein a portion of the compressed air is supplied to said air separation unit.
5. A process as claimed in any of the preceding claims wherein the exhaust gases from the gas turbine are passed through a heat exchanger to recover heat for use in the process.

6. A chemical plant apparatus for producing a liquid hydrocarbon product from a hydrocarbon feedstock and steam comprising:
- a) a heat exchange primary reformer which comprises a shell, a plurality of reaction tubes disposed within said shell and containing a reforming catalyst, and means for flowing a heat transfer medium within said shell to heat said reaction tubes,
  - b) a secondary reformer comprising an upstream combustion region and a downstream reforming region comprising a bed of a reforming catalyst, and means to introduce an oxygen-rich gas comprising >90% oxygen and a primary reformed gas into said combustion region,
  - c) means to transfer a secondary reformed gas from said secondary reformer into the shell of said primary reformer
  - d) means for transferring said secondary reformed gas from said primary reformer shell via dewatering means to a hydrocarbon synthesis reactor
  - e) a hydrocarbon synthesis reactor
  - f) means for separating a synthesised hydrocarbon stream produced in said hydrocarbon synthesis reactor into a liquid hydrocarbon product stream and a tail gas stream
  - g) gas turbine apparatus comprising an air compressor, a combustion chamber and a turbine unit
  - h) means for transferring at least a portion of said tail gas to the combustion chamber of said gas turbine.
7. An apparatus as claimed in claim 6, further comprising an air separation unit for separating air into an oxygen-rich gas for supply to said secondary reformer and a nitrogen-containing gas.
8. An apparatus as claimed in claim 7, further comprising means to introduce said nitrogen-containing gas into said gas turbine apparatus.
9. An apparatus as claimed in claim 7 or claim 8, further comprising means to introduce compressed air generated by said air compressor into said gas turbine apparatus.